



# National Transportation Safety Board Aviation Accident Final Report

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<b>Location:</b>	San Francisco, CA	<b>Accident Number:</b>	LAX04LA050
<b>Date &amp; Time:</b>	11/14/2003, 1250 PST	<b>Registration:</b>	N178UA
<b>Aircraft:</b>	Boeing 747-422	<b>Aircraft Damage:</b>	Substantial
<b>Defining Event:</b>		<b>Injuries:</b>	356 None
<b>Flight Conducted Under:</b>	Part 121: Air Carrier - Scheduled		

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## Analysis

The airplane experienced a tail strike on rotation. The first officer was the flying pilot for the takeoff on runway 10L. The winds were from 180 degrees at 16, gusting to 22 knots. The takeoff roll was normal, and the flying pilot utilized control wheel input to correct for the crosswind. A few seconds after rotation, the crew noted the stick shaker annunciate, and flying pilot responded by gently easing back pressure off the control yoke. The crew returned to land at the departure airport after controllers in the tower reported that the airplane may have struck the tail. Flight Data Recorder (FDR) information indicated that the takeoff occurred during directionally variable wind conditions. The wind shifted during the takeoff roll, resulting in a decreasing headwind, an increasing crosswind, and finally to an average 8-knot tailwind during rotation. The maximum pitch rate during rotation was slightly higher than average, but within the normal expected variation. Analysis of the data showed this was a minor contributor to the tail strike. The flying pilot used significant wheel input (35 degrees right wheel) to counter the increasing crosswind, which resulted in the right spoiler raising 12 degrees and a corresponding loss of lift due to the use of spoilers. Rotating at a lower airspeed requires a higher angle of attack, and therefore, a higher pitch attitude to achieve liftoff. The combination of the tailwind gust and spoiler movement resulted in the airplane's pitch attitude exceeding 12.6 degrees while the gear was still on the ground. This resulted in the aft body contact with the runway. During a typical takeoff in gusty or strong crosswind conditions, the manufacturer recommended maximum takeoff thrust and to avoid rotation during a gust. Slightly delaying rotation would allow the airplane additional time to accelerate through the gust, and the greater airspeed would improve the tail clearance margin. The FDR-recorded longitudinal control system parameters suggested a properly functioning system. The airplane motion was consistent with the control inputs and power settings.

## Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: a tail strike due to a combination of the wind shifting from a headwind to a tailwind during rotation, and the pilot's control inputs for the crosswind condition.

## Findings

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Occurrence #1: DRAGGED WING, ROTOR, POD, FLOAT OR TAIL/SKID

Phase of Operation: TAKEOFF

### Findings

1. TERRAIN CONDITION - RUNWAY
2. (C) WEATHER CONDITION - SUDDEN WINDSHIFT
3. (C) FLIGHT CONTROLS - IMPROPER USE OF - COPILOT/SECOND PILOT
4. (C) ROTATION - PREMATURE - COPILOT/SECOND PILOT

## Factual Information

On November 14, 2003, about 1250 Pacific standard time, United Airlines Flight 805, a Boeing 747-422, N178UA, experienced a tail strike on rotation at San Francisco, California. United Airlines, Inc., was operating the airplane as a scheduled international passenger flight under the provisions of 14 CFR Part 121. The airline transport pilot licensed captain, 3 aircrew members, 17 flight attendants, and 335 passengers were not injured. The airplane sustained substantial damage. The flight was en route as a non-stop to Hong Kong, China. Visual meteorological conditions prevailed, and an instrument flight rules (IFR) flight plan had been filed.

The operator submitted a written report. The first officer was the Pilot Flying (PF), and the airplane departed on runway 10L. The winds were 180 at 16, gusting to 22 knots. The takeoff roll was normal, and the PF utilized control wheel input to correct for the crosswind. A few seconds after rotation, the PF noted the stick shaker annunciate, and responded by gently easing back pressure off the control yoke. The captain and a relief pilot felt a nose wheel vibration following the takeoff.

The air traffic control tower contacted the flight crew alerting them of a possible tail strike after observing smoke from the airplane at rotation. The crew returned to land at San Francisco. Evaluation of the damage resulted in structural repair to two structural members.

A National Transportation Safety Board specialist examined the solid state flight data recorder (FDR) and prepared a factual report. It included graphical plots of pertinent data. Boeing also evaluated the FDR data.

The data indicated that the takeoff occurred during variable wind conditions. The wind shifted resulting in a decreasing headwind, and an increasing crosswind, to an average 8-knot tailwind during rotation. During the takeoff roll, the data showed right control wheel inputs and left rudder pedal, suggesting that the winds had a crosswind component from the right. The maximum pitch rate was slightly higher than average, but within the normal expected variation. Boeing felt that this was a minor contributor to the tail strike. The PF used significant wheel input (35 degrees right wheel); this resulted in the right spoiler raising 12 degrees. Boeing pointed out that there was a loss of lift due to the use of spoilers. They also pointed out that rotating at a lower airspeed requires a higher angle of attack, and therefore, a higher pitch attitude to achieve liftoff. The combination of the tailwind gust and spoiler movement resulted in the airplane's pitch attitude exceeding 12.6 degrees, while the gear was still on the ground. This resulted in the aft body contact with the runway.

Boeing discussed a typical takeoff in gusty or strong crosswind conditions. They recommended maximum takeoff thrust, and to avoid rotation during a gust. Slightly delaying rotation would allow the airplane additional time to accelerate through the gust, and the greater airspeed would improve the tail clearance margin.

The FDR-recorded longitudinal control system parameters suggested a properly functioning system. The airplane motion was consistent with the control inputs and power settings.

## Pilot Information

<b>Certificate:</b>	Airline Transport	<b>Age:</b>	56, Male
<b>Airplane Rating(s):</b>	Multi-engine Land; Single-engine Land	<b>Seat Occupied:</b>	Left
<b>Other Aircraft Rating(s):</b>	None	<b>Restraint Used:</b>	Seatbelt, Shoulder harness
<b>Instrument Rating(s):</b>	Airplane	<b>Second Pilot Present:</b>	Yes
<b>Instructor Rating(s):</b>	None	<b>Toxicology Performed:</b>	No
<b>Medical Certification:</b>	Class 1	<b>Last FAA Medical Exam:</b>	07/01/2003
<b>Occupational Pilot:</b>	<b>Last Flight Review or Equivalent:</b>		
<b>Flight Time:</b>	11999 hours (Total, all aircraft), 243 hours (Last 90 days, all aircraft), 51 hours (Last 30 days, all aircraft)		

## Co-Pilot Information

<b>Certificate:</b>	Airline Transport	<b>Age:</b>	42, Male
<b>Airplane Rating(s):</b>	Multi-engine Land; Single-engine Land	<b>Seat Occupied:</b>	Right
<b>Other Aircraft Rating(s):</b>	None	<b>Restraint Used:</b>	Seatbelt, Shoulder harness
<b>Instrument Rating(s):</b>	Airplane	<b>Second Pilot Present:</b>	Yes
<b>Instructor Rating(s):</b>	None	<b>Toxicology Performed:</b>	No
<b>Medical Certification:</b>	Class 1	<b>Last FAA Medical Exam:</b>	09/01/2003
<b>Occupational Pilot:</b>	<b>Last Flight Review or Equivalent:</b>		
<b>Flight Time:</b>	9702 hours (Total, all aircraft), 215 hours (Last 90 days, all aircraft), 76 hours (Last 30 days, all aircraft)		

## Aircraft and Owner/Operator Information

Aircraft Make:	Boeing	Registration:	N178UA
Model/Series:	747-422	Aircraft Category:	Airplane
Year of Manufacture:		Amateur Built:	No
Airworthiness Certificate:	Transport	Serial Number:	24385
Landing Gear Type:	Retractable - Tricycle	Seats:	370
Date/Type of Last Inspection:	07/01/2003, Continuous Airworthiness	Certified Max Gross Wt.:	875000 lbs
Time Since Last Inspection:		Engines:	4 Turbo Fan
Airframe Total Time:	57337 Hours as of last inspection	Engine Manufacturer:	Pratt & Whitney
ELT:	Not installed	Engine Model/Series:	PW4056
Registered Owner:	Wilmington Trust Co	Rated Power:	56000 lbs
Operator:	UNITED AIR LINES INC	Operating Certificate(s) Held:	Flag carrier (121)
Operator Does Business As:		Operator Designator Code:	UALA

## Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual Conditions	Condition of Light:	Day
Observation Facility, Elevation:	SFO, 13 ft msl	Distance from Accident Site:	0 Nautical Miles
Observation Time:	1256 PST	Direction from Accident Site:	
Lowest Cloud Condition:		Visibility	10 Miles
Lowest Ceiling:	Overcast / 4600 ft agl	Visibility (RVR):	
Wind Speed/Gusts:	16 knots / 22 knots	Turbulence Type Forecast/Actual:	/
Wind Direction:	180°	Turbulence Severity Forecast/Actual:	/
Altimeter Setting:	30.09 inches Hg	Temperature/Dew Point:	17° C / 11° C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	San Francisco, CA (SFO)	Type of Flight Plan Filed:	IFR
Destination:	Hong Kong (HKG)	Type of Clearance:	IFR
Departure Time:	1250 PST	Type of Airspace:	

## Airport Information

Airport:	San Francisco International (SFO)	Runway Surface Type:	Asphalt
Airport Elevation:	13 ft	Runway Surface Condition:	Dry
Runway Used:	10L	IFR Approach:	Visual
Runway Length/Width:	11870 ft / 200 ft	VFR Approach/Landing:	Precautionary Landing

## Wreckage and Impact Information

<b>Crew Injuries:</b>	21 None	<b>Aircraft Damage:</b>	Substantial
<b>Passenger Injuries:</b>	335 None	<b>Aircraft Fire:</b>	None
<b>Ground Injuries:</b>	N/A	<b>Aircraft Explosion:</b>	None
<b>Total Injuries:</b>	356 None	<b>Latitude, Longitude:</b>	37.618889, -122.391389

## Administrative Information

<b>Investigator In Charge (IIC):</b>	HOWARD D PLAGENS	<b>Report Date:</b>	04/25/2007
<b>Additional Participating Persons:</b>	David Johnson; Federal Aviation Administration CMO; San Francisco, CA Jeff Plantz; United Airlines; Chicago, IL Simon Lie; Boeing; Seattle, WA		
<b>Publish Date:</b>			
<b>Investigation Docket:</b>	NTSB accident and incident dockets serve as permanent archival information for the NTSB's investigations. Dockets released prior to June 1, 2009 are publicly available from the NTSB's Record Management Division at <a href="mailto:pubinq@ntsb.gov">pubinq@ntsb.gov</a> , or at 800-877-6799. Dockets released after this date are available at <a href="http://dms.nts.gov/pubdms/">http://dms.nts.gov/pubdms/</a> .		

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The Independent Safety Board Act, as codified at 49 U.S.C. Section 1154(b), precludes the admission into evidence or use of any part of an NTSB report related to an incident or accident in a civil action for damages resulting from a matter mentioned in the report. A factual report that may be admissible under 49 U.S.C. § 1154(b) is available [here](#).